

Planning for Measurement and Analysis

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Software Process Improvement (SPI) Project

Purpose and Objectives

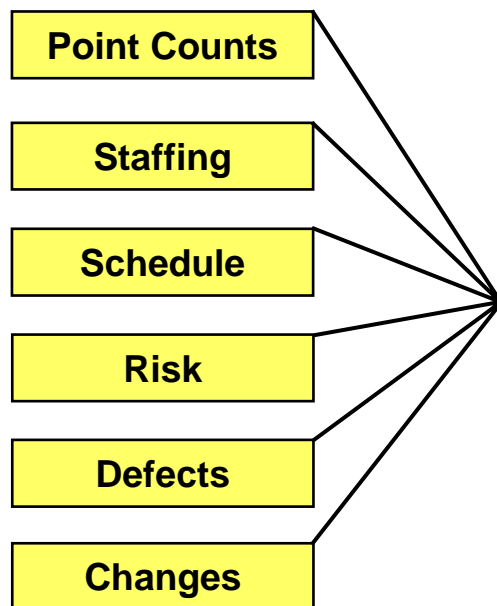
- **Purpose:** To help you plan measurement and analysis activities for your project
- **Objective - After this session you should understand:**
 - The kinds of things you need to measure
 - The steps for planning measurement activities
 - What's involved in each step
 - What tools are available from the SPI Project to help you

Why You Should Measure

- **For the benefit of your current project**
 - Use objective measurement data to plan, track, and correct project
- **For the benefit of your future projects (and the rest of Goddard's, too!)**
 - Help create basis for planning future projects
 - Provide a subset of your measures to SPI
- **Because it's required!**
 - Comply with NPR 7150.2 measurement requirements
 - SPI Tools meet these requirements by design

Measures Help You Manage!

Collect and Store



Analyze



Report

I'm on plan
or
I'm varying
from plan
or
I'm off plan
and need
help!!!!

NPR 7150.2 Measurement Requirements for Class B Projects

- **Required measurement areas for all software projects**
 - Software Progress Tracking
 - Software Functionality
 - Software Quality
 - Software Requirements Volatility
 - Software Characteristics
- **Additional NPR requirements for Class A and B projects**
 - Process monitoring as required for CMMI Capability Level 2
 - Data specified for Software Inspection/Peer Review Report
 - Data collected “on a CSCI basis”

- **The good news ... SPI resources are available**
 - **The “Measurement and Analysis for ISD Projects” process**
 - **Document templates and guidelines**
 - **SPI measurement toolset**
- **Your existing toolset may already be doing a lot of what is required**
 - ... and the SPI tools are here if you need them**

Measurement Process* Steps

- 1. Establish measurement objectives**
- 2. Identify the essential measurement analyses that support these objectives**
- 3. Specify the measures to be collected**
- 4. Specify data collection and storage procedures**
- 5. Specify analysis procedures**
- 6. Collect measurement data**
- 7. Analyze collected data**
- 8. Store collected data and analysis results**
- 9. Communicate results to stakeholders**

* <http://software.gsfc.nasa.gov/AssetsApproved/PA3.4.doc>

Use Measurement Planning Products to Get Started

SMP/PP Metrics Table

- Use the *Measurement Planning Table* in the Software Management Plan/Product Plan Boilerplate Tool*
- Create the metrics table in the SMP/PP defining
 - Measurement objectives
 - Measures and how they are analyzed
 - Collection frequency for the data

Collection and Storage Procedure

- Use the Data Collection and Storage Procedure Template**
- Define a project-specific collection and storage procedure
 - The tools used
 - The person responsible
 - Where the data is stored

*<http://software.gsfc.nasa.gov/tools.cfm>

**<http://software.gsfc.nasa.gov/AssetsApproved/PA3.4.1.2.doc>

■ Objectives define what outcome measurement is working towards

- Objectives in planning table meet the NPR 7150.2 requirements
- Consider whether you have objectives beyond what is in prepackaged set.

Measurement Area	Measurement Objective
Software progress and cost tracking	Ensure schedule progress is within acceptable bounds
	Ensure project effort and costs remain within acceptable bounds.
	Ensure project issues are identified and resolved in a timely manner

Practical Considerations For Selecting Measures

- **How will I know when the project is okay or when the project is in trouble?**
 - What questions will I need to answer?
 - What are typical measures in other organizations?
 - How will I interpret and present data?
 - When will I need to take corrective action?
- **How can I maximize benefit and minimize cost of measurement?**
 - Is collection “in line” with what’s being measured?
 - Does my current toolset do the job, or nearly so?

Step 2: Define Measurement Analyses

Measurement Area	Measurement Objective	Analysis Summary
Software progress and cost tracking	Ensure schedule progress is within acceptable bounds	Compare planned vs. actual schedule. <i>Take corrective action if the deviation exceeds 10%.</i>

Guides analysis presented in status reports

Analysis: [fill in]
Impact: [fill in]
Corrective action: [fill in]

- Initial approach is pre-packaged in “Analysis Summary Column”
- Tailor for your approach to *analyzing data*, e.g.,
 - Compare planned and actual values
 - Examine trends over time
- *Set thresholds* for when you need to act (replace/accept blue text)
 - Use numbers or relate back to cost/schedule impact

Step 3: Specifying Specific Measures

- Choose from measures in the Measurement Planning Table
 - Asterisk at top of “Measures” column indicates measures collected by SPI project
 - Alternate measures that also meet objectives are okay
- Decide frequency of collection
 - Blue text indicates *minimum* collection frequency

Measurement Area	Measurement Objective	Analysis Summary	Measure(s) (Asterisk (*) indicates reporting of this measure to the GSFC EPG is required.)	Collection Frequency (for project mgmt., not EPG reporting)
Software progress and cost tracking	Ensure schedule progress is within acceptable bounds	Compare planned vs. actual schedule. <i>Take corrective action if the deviation exceeds 10%.</i>	*Planned Event Dates	Upon completion of the project plan (or re-plan)
			*Actual event dates	<i>Monthly</i>

The Measurement Planning Table Puts It All Together

Measurement Area	Measurement Objective	Analysis Summary	Measure(s) (Asterisk (*) indicates reporting of this measure to the GSFC EPG is required.)	Collection Frequency (for project mgmt, not EPG reporting)	Selection Rules & Guidance (Classes of software projects are defined in NPR 7150.2.)
Software progress and cost tracking	Ensure schedule progress is within acceptable bounds	Compare planned vs. actual schedule. <i>Take corrective action if the deviation exceeds 10%.</i>	*Planned Event Dates	Upon completion of the project plan (or re-plan)	<p>Rules</p> <p>1) Minimum required reporting is of one measure of schedule progress and one measure of cost or effort.</p> <p>2) Class A, B & C projects are required to track scheduled process events (e.g. reviewed SMP) as well as scheduled product events (e.g. Build 1 ready to test). Class A, B, F and G projects are required to track and report data at the CSCI level; others are allowed to report totals at the project level.</p> <p>3) At a minimum, measures listed with an asterisk (*) must be reported to the GSFC EPG at the following milestones: project start, CDR, end of test, and delivery to the maintenance team. Examples of milestone events beyond the minimum are PDR and beginning of system test. Use of the Measurement Summary Tool (available at http://software.gsfc.nasa.gov/tools.cfm) for this reporting is highly recommended.</p> <p>Guidance</p> <p>Recording action item (AI) metrics is an added option that is recommended, especially if the project's AI-tracking tool produces easily reportable results.</p>
			*Actual event dates	Monthly	
		Compare planned progress points vs. actual progress points. <i>Take corrective action if the deviation exceeds 10%.</i>	Planned Progress tracking points	Upon completion of the project plan (or re-plan)	
			Actual Progress tracking points	Bi-weekly	
	Ensure project effort and costs remain within acceptable bounds.	Compare planned vs. actual effort. <i>Take corrective action if the deviation exceeds 10%.</i>	*Total Planned Effort (FTEs for civil servants and contractors)	Upon completion of the project plan (or re-plan)	
			*Total Actual Effort (FTEs for civil servants and contractors)	Monthly	
		Compare planned vs. actual costs. <i>Take corrective action if the deviation exceeds 10%.</i>	Planned Facility and equipment costs	Upon completion of the project plan (or re-plan)	
			Actual Facility and equipment	Monthly	

*<http://software.gsfc.nasa.gov/tools.cfm>

Instructions for Using the Measurement Planning Table

- **Use the “Selection Rules and Guidance”**
 - **Selection rules** must be followed for NPR compliance
 - **Guidance** is to help you select measures
- **Editing the table**
 - **Blue text** indicates area to replace text with project-specifics
 - If you’ve added objectives, you need to define analyses measures that address them and add row(s) accordingly
 - Delete rows for measures not selected for use
 - Remove the rightmost column for final product

Planning Considerations for Measuring a Contractor's Work

- **Contractor work may be within NPR 7150.2 scope ...**
 - If started after NPR effective date of 9/27/04 and
 - If contract references NPR 7150.2 in contract itself
- **Measurement data should be part of deliverables**
 - Make sure you specify a good set of measures in the RFP -- you can negotiate minor changes later if necessary
 - Amend existing contracts (eventually) to define measures
 - Generally should use the same sort of measures as in-house projects, e.g.,
 - Contractor earned value reports may cover software progress requirement
 - Planned and actual delivery dates
 - Test results or count of outstanding problems

Planning Considerations for Measuring Your Acquisition Work

- **Projects acquiring Class B software are required to have acquisition process measures**
 - **Planned and actual effort**
- **Consider adding other objectives**
 - **Assure that government completes work on time**
 - **How long does contract / amendment take in the procurement office?**
 - **How long does it take to accept deliveries?**
 - **Assure quality of government work**
 - **Are requirements complete and stable?**
 - **Are acquisition processes passing audits?**

Software Progress Tracking Objectives and Measures

■ Objectives

- Keep cost and schedule within acceptable bounds
- Monitor effort by process activity to assure correct staffing

■ Typical measures – Planned and actual data for ...

- Event dates
- Progress tracking points
- Budget and staff effort
- Effort for each process activity

■ Selection rules

- Require at least one measure of schedule progress and one measure of cost or effort
- Require process measures for each CMMI process area

Software Functionality Objectives and Measures

- **Objective**
 - Deliver required software functionality
- **Typical measures**
 - Planned and delivered number of requirements for each release or build
 - Total number of requirements
 - Planned and actual memory utilization for each CSCI
- **Selection rules**
 - You are required to use at least one measure of planned and actual functionality

Software Quality

Objectives and Measures

- **Objectives**
 - Avoid delivering software containing defects
 - Minimize rework due to defects
- **Typical measures**
 - Number of defects by severity
 - Open and closed defects by severity
 - Length of time open by severity
- **Selection rules**
 - Required to count defects by severity
 - Required to use a measure of timely closing of defects

Selecting Measures for Software Quality

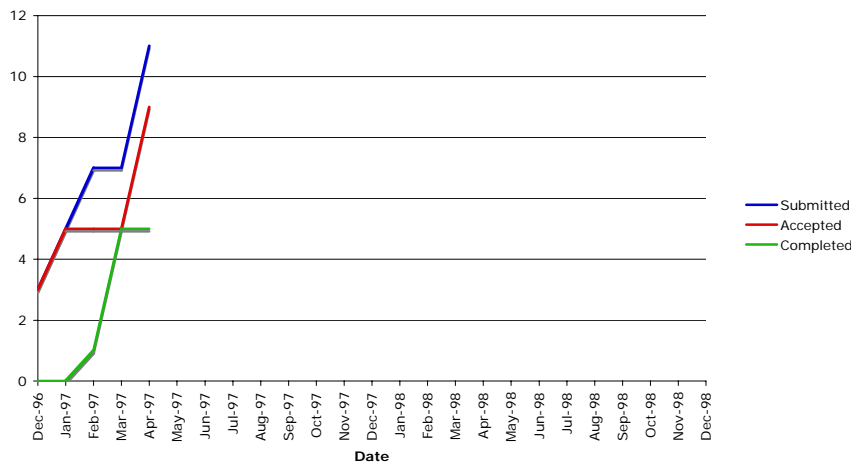
Objective: Deliver defect-free software

How will I tell if I am keeping up with problem reports?

How will I see where the severe problems are?

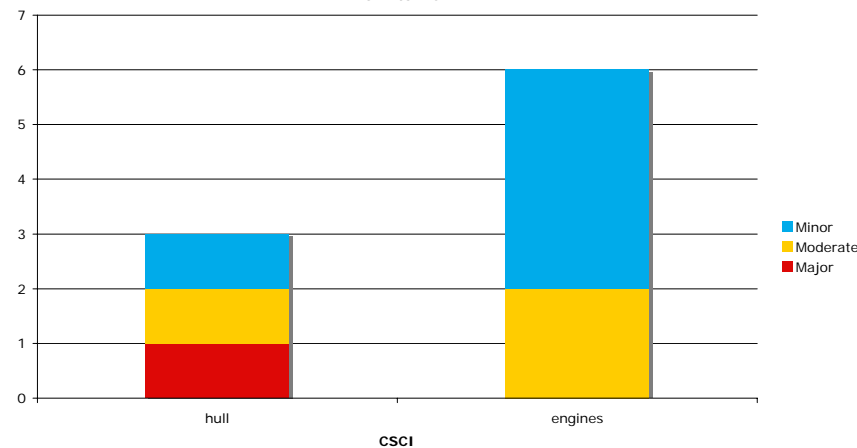
Status Trends

Problem Report Progress
RMS Titanic



Severity Snapshot

Problem Severity by CSC1
RMS Titanic



Software Requirements Volatility

Objectives and Measures

■ Objectives

- Implement from a complete, stable set of requirements

■ Typical measures

- Number of requirements changes
 - Total changes is sum of additions, deletions and modifications
- Number of requirements TBDs

■ Selection rules

- Required to use both measures

- **Software Characteristics are defined as:**
 - For project -- name and software type
 - Type can be flight, ground, science, other
 - For each CSCI
 - Name, primary language, COTS/MOTS/GOTS used, platform (hardware and OS)
 - Final size and units used to measure size
- **All of these measures are required**
 - Used to help future projects that are similar to yours

NPR 7150.2- Specified Inspection Measures

- **“Software Inspection/Peer Review Report” in NPR 7150.2, section 5.3.3.1 requires:**
 - Date and type of inspection
 - Name of document being inspected
 - Preparation, meeting and follow-through effort
 - Number of participants
 - Number of defects found by severity
 - Result (pass or need to re-inspect corrections)
- **Inspection Moderator Tool*** meets these requirements and generates metrics report data

[*http://software.gsfc.nasa.gov/tools.cfm](http://software.gsfc.nasa.gov/tools.cfm)

Step 4: Specify Data Collection and Storage Procedure

- **Edit template to create project-specific procedure**
 - **Measurement Data Collection and Storage Procedure Template***
- **Copy and paste into SMP/PP appendix**
- **You can also make your procedure a document separate from the SMP/PP**
 - **If procedure is separate, list it on the DML**

[*http://software.gsfc.nasa.gov/AssetsApproved/PA3.4.1.2.doc](http://software.gsfc.nasa.gov/AssetsApproved/PA3.4.1.2.doc)

Using the Data Collection and Storage Procedure Template (1 of 2)

■ Edit the step action table

- Remove general advice (light blue italicized text)
- Fill in project-specific information (dark blue text in brackets)
- List individuals or roles *providing* data in step 1

■ There is also project-specific information (e.g., project name!) in main text of template

Step	Action	Role
1	<p>Collect raw measurement data from originators.</p> <p><i>“Originators” are those who provide the raw measurement data to those who collect it. Originators include:</i></p> <ul style="list-style-type: none"> • <i>Inspection moderators for inspection reports</i> • <i>PDL or team lead for problem reports</i> • <i>All team members for effort and progress data</i> • <i>PDL or team lead for requirements data</i> • <i>PDL for software characteristics</i> <p><i>In some cases, the person responsible for collecting the data (the “Responsible Person” in Table 1) may also be the originator of the data.</i></p>	<p>1) “Responsible Person” listed in Table 1.</p> <p>2) Originator: <i>List originators here by role, see advice to the left for possible roles.</i></p>
2	<p>Record measures using the appropriate spreadsheet tool, as shown in Table 1.</p> <p>Guidance: Detailed instructions for data entry are provided with each of the spreadsheet tools shown in Table 1.</p>	Responsible person listed in Table 1.
3	<p>For Software Characteristics only, e-mail the data to the [SPI Measurement Team Lead]</p> <p><i>The current SPI Measurement Team Lead is Mike Stark, who can be reached at michael.e.stark@nasa.gov</i></p>	Responsible person listed in Table 1.
4	<p>Store each updated spreadsheet in the [measurement repository specified in the Data Management List (DML)] (e.g., <i>directory and server name</i>)</p>	Responsible person listed in Table 1.
5	<p>Upon retrieving and analyzing data, store any updates to the spreadsheets back to the repository.</p> <p>Guidance: This activity is in addition to the work being done to produce status report charts. Any analysis not presented in status reports should be recorded within the appropriate tool so that the analysis is documented and retained.</p>	PDL/Team Lead

Using the Data Collection and Storage Procedure Template (2 of 2)

■ Edit Table 1 (Tools Table)

- Add/delete/replace tools as needed
- If using non-SPI tools, change table accordingly

- E.g., replace with Bugzilla

- List person doing work as responsible person
- Change collection frequency as needed

■ Notes

- Can have multiple uses of the same tool

Measures	Tool	Collection Method	Responsible Person	Collection Frequency
Software Progress and Cost Tracking	Staffing Tool	Direct Entry	[PDL Name]	Weekly
	Point Counting Spreadsheet	Direct Entry	[PDL Name]	Weekly
	Schedule Tool	Direct Entry	[PDL Name]	Weekly
Software Quality	Problem Report (PR) Tool	Direct Entry	[PDL Name]	As each PR is entered and as status is updated
	Inspection Metrics Tool [OR Status Reporting Tool]	Cut and paste data from each Inspection Moderator report.	[PDL Name]	At time inspection is approved by the Inspection Moderator and closed out.
Software Requirements Volatility	Requirements Metrics Tool, RQ By Date worksheet	Direct Entry	[PDL Name]	Monthly
Software Functionality	Requirements Metrics Tool, RQ by Build worksheet	Direct Entry	[PDL Name]	Monthly
Software Characteristics	Measurement Summary Tool	Direct Entry	[PDL Name]	At major milestones

Step 5: Specify Analysis Procedure(s) Outline

- **Administration overview**
 - Who analyzes and presents data
 - When and where is this done
 - Analysis should be done at least once a month
 - At a consistent time (e.g., first of month)
- **Procedures (1 per measurement area)**
 - Objectives and measures
 - Use information from tables (can cut and paste rows)
 - Analyses
 - Describe reports and graphs
 - Describe potential causes of deviation
 - Describe potential impacts and corrective action

Other Measurement Considerations

- **Provide data to SPI at milestones (including start, end)**
 - Provide data using **Measurement Summary Tool***
 - Will be used to help future projects
 - Data is made anonymous, then analyzed to define expected productivity, error rates,...
- **Miscellaneous important documentation**
 - **Roles and Responsibilities:** Add name of person with overall responsibility for measurement (PDL, usually) to **Roles and Responsibilities Table***
 - **Schedule:** need measurement events on schedule; periodic (monthly) plan to analyze data is a good one

[*http://software.gsfc.nasa.gov/tools.cfm](http://software.gsfc.nasa.gov/tools.cfm)

■ SPI tools

- Software Progress: **Staffing Tool, Schedule Tool, Point Counting Tool**
- Software Quality: **Inspection Moderator's Tool, Inspection Metrics Tool, Problem Report Tool**
- Software Functionality, Software Requirements Volatility: **Requirements Metrics Tools**
- Software Characteristics: **Measurement Summary Tool**

■ Tools can be found at

<http://software.gsfc.nasa.gov/>

- If you already have your own tools that meet the requirements, that's good, too!

Summary

- **Measurement is a good management practice**
 - Helps uncover unpleasant surprises early (when you might stand a chance of recovery)
- **Select measures linked to your project's goals**
 - SPI measures address most common objectives
 - SPI tools help collect, store, analyze and report with respect to these objectives (And meet NPR 7150.2 and CMMI requirements, too!)
- **Define measurement procedures as part of planning**
 - Makes responsibilities clear for who provides, collects, stores, analyzes and presents data.
- **SPI assets are your starting point, not your final plan**
- **Next week: *Executing Your Measurement Plans***

Questions?

Acronyms

- CMMI – Capability Maturity Model Integrated
- COTS – Commercial Off-the-Shelf
- CSCI – Computer Software Configuration Item
- DML – Data Management List
- GOTS – Government Off-the-Shelf
- ISD – Information Systems Division (now System Engineering Division)
- M&A – Measurement and Analysis
- MOTS – Modified Off-the-Shelf
- NPR – NASA Procedural Requirement
- OS – Operating System
- PDL – Product Development Lead
- PP – Product Plan
- RFP – Request for Proposal
- SMP – Software Management Plan
- SPI – Software Process Improvement
- TBD – To Be Determined